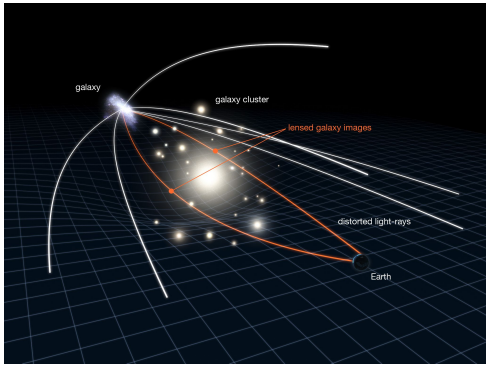
Galaxy clusters in LSST working group

- The goal of the working group is to obtain constraints on Ω_m and σ_8 from the λ - CDM
- To use galaxy clusters as a probe, we want to analyze the number of clusters in the sky and the lensing signal from source galaxies behind the cluster
- For this analysis we need:
  - Data (simulations for the moment)
  - Organize the data into catalogs with the needed information
  - Make the theoretical predictions (counts, weak lensing, covariance)
  - Implement the likelihood between data and prediction
  - Run an MCMC



Data

Given an area, redshift and richness region of the sky:

- The number **N** of clusters in a region of the sky
- The shear signal from source galaxies behind the cluster

$$\gamma_+(\vartheta) := \oint \frac{\mathrm{d}\varphi}{2\pi}\,\gamma_+(\vartheta,\varphi) = \overline{\kappa}(\vartheta) - \kappa(\vartheta) \equiv \frac{\Delta\Sigma(\vartheta)}{\Sigma_{\rm cr}}$$
$$\gamma_\times(\vartheta) := \oint \frac{\mathrm{d}\varphi}{2\pi}\,\gamma_\times(\vartheta,\varphi) = 0,$$

Theory Prediction

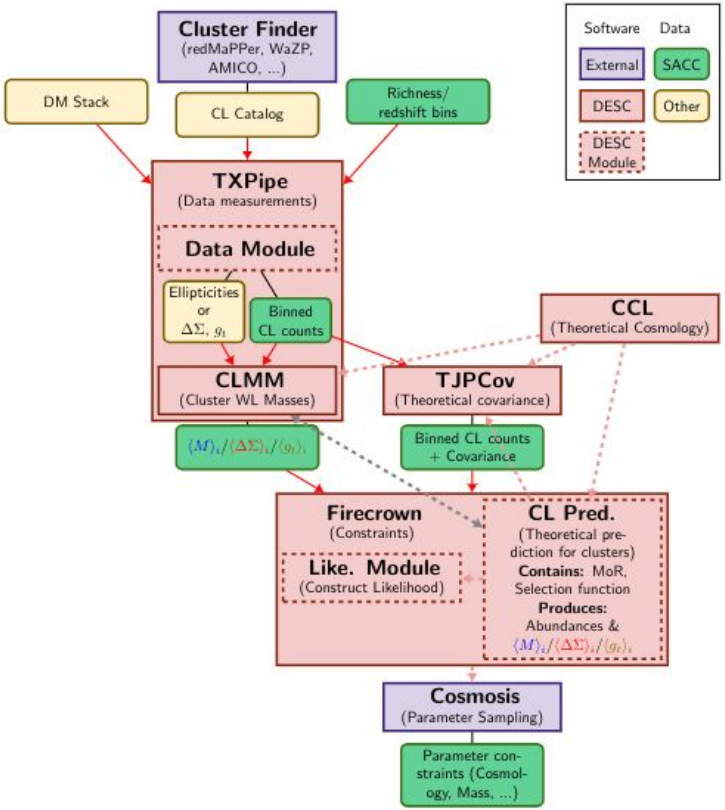
- Counts prediction (binning in z-richness)

$$N_\alpha^\beta = \int_{z_\alpha}^{z_{\alpha+1}} \mathrm{d}z\,\frac{dV}{dz d\Omega}\int_{\ln\lambda_\beta}^{\ln\lambda_{\beta+1}} \mathrm{d}\ln\lambda\int_0^\infty \mathrm{d}M\,\frac{dn}{dM}P\,(\ln\lambda|M,z)$$

- Shear profile prediction

$$\Delta\Sigma_{\lambda_\beta}(R) \equiv \frac{1}{N_{\Delta\Sigma}(R;\,\lambda_{\beta,\min},\,\lambda_{\beta,\max})} \times \int_{z_{\min}}^{z_{\max}} dz \int_{M_{\min}}^{M_{\max}} dM\,\frac{\chi^2(z)}{H(z)} \times w_l(z;\,R)\frac{dn}{dM}S(M|\lambda_{\beta,\min},\,\lambda_{\beta,\max})\Delta\Sigma(R;\,M,\,z)$$

The Desc Cluster Pipeline



Firecrown

Python package that offers the DESC framework for implementing likelihood

Key properties	Relevant cluster codes
• Dedicated likelihood implementations for 3x2 point, weak lensing, cluster counts, super nova, etc. • Connection with cosmosis (MCMC) and NumCosmo. • Data Reading	**Cluster theory model**
	Cluster counts prediction implementation • true mass/true redshift • Mass proxy / redshift proxy
	Cluster Number Counts statics
	Likelihood construction, data reading/writing.

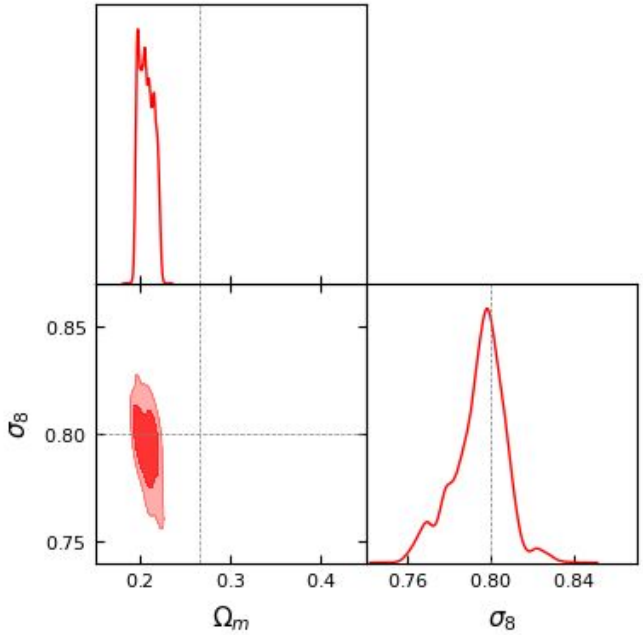
Requirements to add new Likelihood to Firecrown

- Add theory predictions for new effect
- Add code to read and organize new data from the SACC format
- Create a recipe for theoretical prediction
- Create new statistics object that will call the recipe

Shear Profile implementation

- I have been working on the theoretical prediction and an statistics object implementation in Firecrown to perform the shear profile analysis

- First test on mock data
  - Wrong evaluation of Ω_m probably due Cov matrix or integration method



Next goals

- Find source of error with ideal data
- Test code on Redmapper catalog run on CosmoDC2
- Add more systematics (misscentering, triaxiality, purity, completeness)
- Start working on TxPipe
- Make sure the systematics used throughout the pipeline are consistent